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Adoption and Impact of Human Resource Analytics (HRA) for Sustainable Workforce Management in the Pakistani Textile Sector

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The textile industry, being the largest employer and export contributor in Pakistan, plays a pivotal role in the country's sustainable economic growth. However, it faces persistent challenges, including high turnover, absenteeism, compliance requirements, and pressure from global buyers to demonstrate sustainable labor practices. Human Resource Analytics (HRA) has emerged as a strategic tool to support sustainable workforce management by enabling evidence-based decision-making that improves both performance and compliance. This research examines the barriers and impacts of HRA adoption in Pakistani textile organizations, employing a qualitative, multi-case study design that incorporates semi-structured interviews with HR executives, analytics experts, production managers, and compliance officers across various subsectors. Findings reveal that although most firms have basic HR information systems, only a minority make strategic use of analytics. Adoption is shaped by technological readiness, leadership commitment, and environmental pressures, particularly from buyers demanding sustainable compliance reporting. Firms that implement HRA report improvements in decision-making processes, reduce absenteeism, optimize overtime expenses, and enhance documentation for sustainability audits. However, significant obstacles remain, including poor data quality, skill gaps, and cultural resistance. This paper contributes by proposing a sector-specific maturity pathway for HRA adoption in Pakistan, ranging from basic compliance reporting to predictive analytics for strategic workforce planning. It emphasizes analytics not only as a performance-enhancing tool but also as a driver of sustainable HRM. The study highlights how the effective use of HRA can simultaneously promote economic efficiency and social sustainability, foster safer and fairer working environments and enhance long-term resilience in Pakistan's textile sector.

Keywords: Human resource analytics (HRA), sustainable workforce management, Pakistan textile sector and international labor organization.

INTRODUCTION

The textile and apparel industry is widely regarded as the backbone of the Pakistani economy. Contributing almost 60 percent of the nation's export earnings and employing about 40 percent of the manufacturing labor force, the sector is both an engine of economic growth and a crucial source of livelihood for millions of workers engaged in spinning, weaving, knitting, dyeing, garment production, and home textiles (Khawaja et al., 2024). Beyond its contribution to export performance, the industry plays a significant social role, supporting entire communities in Punjab and Sindh, where textile employment underpins household incomes. Despite being important, the competitiveness of the sector is increasingly challenged by fluctuations in global demand, escalating labor costs, demands for automation, energy accessibility issues, and compliance requirements from international buyers. These pressures suggest that human resource management is no longer just an administrative process, but is a crucial determinant of productivity, quality, and the outlook for sustainability in the textile industry (Dasari & Devi, 2024).

Historically, human resource management in Pakistani textile companies has primarily focused on transactional activities, including payroll processing, attendance systems, and maintaining personnel records. HR departments were often not considered a strategic part in decision-making, and the primary purpose of data communication was mainly to

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document and comply (Khalid et al., 2021; Lakhiar et al., 2021). However, global competition and international compliance requirements in the areas of labor, e.g., the Pakistan Accord on Health and Safety in the Textile and Garment Industry introduced in 2023, as well as many other initiatives of the International Labor Organization (ILO), are increasingly forcing companies to apply more transparent, data-driven, and strategic HR practices (Qayoom et al., 2019; Sciences and 2022). International buyers have now demanded proof—both of compliance with labor standards and of sustainable and ethical workforce practices. For many Pakistani textile exporters, the ability to collect, analyze, and act on workforce data has accounted for an essential prerequisite for retention of contracts, audit requirements to stay compliant, and to stay profitable in a volatile global supply chain (Qayoom et al., 2019).

Human Resource Analytics (HRA) has become a key tool in addressing these problems. It can be described as the gathering, examination, and interpretation of workforce information in an organized way, facilitated by various advanced statistical and forecasting techniques, which allow organizations to make sound decisions regarding HR related information (Ioakeimidou et al., 2024). HRA is recognized worldwide for its effectiveness in maximizing recruitment efficacy, identifying employee turnover, facilitating shift planning, determining training needs, reducing absence rates, and supporting diversity and inclusion initiatives. In developed economies, companies are increasingly turning to analytics not only to tap into the past experiences of their workforce but also to forecast behavior and institute proactive interventions with direct connections to HR, operational effectiveness, and financial results (Galizia et al., 2015). Recent literature has also highlighted the importance of HRA in providing sustainable workforce practices, ensuring transparency, accountability, and fairness in HRM, and connecting people-related decisions with the broader sustainability objectives of organisations (Iqbal et al., 2025).

However, HRA in Pakistan is poorly implemented and underdeveloped. Although larger corporations, especially those highly integrated into global supply chains, have capitalized on human resource information systems (HRIS) or enterprise resource planning (ERP) systems for human resource management, they have typically been reduced to administrative bookkeeping (Iqbal et al., 2025). Little is done with their capacity to make strategic decisions. The barriers to the adoption of advanced analytics in the textile industry in Pakistan are noticeable, including a deficiency in technological infrastructure, inadequate investment in data systems, data illiteracy among the HR department, resistance to change, and insufficient leadership commitment. The role of HR is often viewed as a support function in most organizations, one that does not offer a competitive edge to the business, and this perception further hinders the integration of analytics into business decision-making. This mismatch between the inertia of simple digital systems and the limited application of data in sustainable HR practices is a significant problem, a shortcoming of an industry that has historically relied heavily on human capital (Sciences et al., 2022).

Although these are limitations, they indicate that change is slowly achieved. The cumulative combination of forces contributing to the adoption of analytics by the textile industry is increasing levels of scrutiny by international customers, compliance audits, high turnover and absenteeism, and intense competition in the skilled labor market (Kamran et al., 2020). Several businesses have begun using dashboards to track workforce-related metrics, including absenteeism, overtime, and safety incidents. Other applications, such as predicting the risks of attrition or evaluating the effectiveness of training programs, are also exploring the potential of the predictive modeling process. These advancements, in depth, are an indication of increased awareness of the HRA's potential to increase compliance, as well as competitiveness. Simultaneously, they also mention an emerging fact: the use of analytics is not only about operational efficiency, but also about aligning the workforce practices with the principles of sustainability (Anner et al., 2022).

Sustainability in the HRM hierarchy does not necessarily mean environmental considerations, but also covers economic, social, and various other dimensions (Kumar et al., 2020). Economic sustainability in the textile industry entails the efficient utilization of resources and minimizing unnecessary expenditures within the industry, as well as adapting to market changes. Social sustainability encompasses fair working conditions, occupational health and safety, equitable treatment, worker involvement, and effective worker retention. Effective workforce management, though with a less strong connection to environmental sustainability, can influence the latter, such as a decrease in rework, better scheduling of shifts, and promotion of safer working practices, which will serve to minimize the effects on the production of goods (Abbas et al., 2024; Yin et al., 2025).

Human Resource Analytics provides an evidence-based approach to address these dimensions, enabling textile companies to balance operational excellence, social responsibility, and compliance with global sustainability standards simultaneously. The issue of sustainability has been raised to high levels, whereby Pakistan is more scrutinized, especially in the textile industry. Such initiatives as the Pakistan Accord and the ILO Decent Work Country Programme (2023-27) demand that the exporters of textiles should generate auditable information about working safety, labor practices, as well as the capability of aligning with the international standards (Iqbal et al., 2025). Buyers are no longer satisfied with verbal attestations and manual documentation; they desire digitally traceable and verifiable data to demonstrate compliance with ethical and sustainable labor practices. In this context, HRA becomes increasingly

not an optional tool, but a necessity for survival in the global value chains. It becomes a bridge between the human capital of the sector and the broader sustainability dialogue, making data-driven HRM a compliance mechanism as well as a strategic driver for building long-term resilience (Galizia et al., 2015).

However, despite its potential, there is a notable lack of academic research in Pakistan examining the adoption of HRA. The existing literature on HR analytics originates from developed economies and knowledge-intensive industries, with limited consideration for their applicability in labour-intensive, export-oriented sectors, such as the textile industry. Even among the regions in South Asia, most studies focus on India or Bangladesh, leaving the context of Pakistan unexplored (Anner et al., 2022; Khan et al., 2015; Management et al., 2025). This absence of empirical evidence is problematic, as the Pakistani textile industry has a unique combination of challenges and opportunities: dependence on exports to Western markets, high workforce turnover, compliance demands from international buyers, and resource constraints that limit the adoption of technology. Understanding how firms navigate these realities while experimenting with analytics is essential to both scholars and practitioners (Kailay, 2024).

This study, therefore, contributes to closing this gap by exploring the adoption and impact of Human Resource Analytics in the Pakistani Textile organisations, with a particular focus on its role in sustainable workforce management. Through an interview-based, multi-case study methodology, the research investigates how HR leaders, analytics professionals, operations managers, and compliance officers view the drivers, barriers, and consequences of HRA adoption. By situating the study in a sector that is both the economic lifeline of Pakistan and an international focal point for labor rights issues, the research presents HRA as not only a tool for work improvement but also a means to promote greater economic, social, and environmental sustainability. This research is both theoretically and practically helpful.

Research Objectives

1. Identify technological, organizational, and environmental factors influencing the adoption of HRA.
2. Evaluate the perceived impacts of HRA on employee outcomes (e.g., turnover, absenteeism), operational efficiency, and regulatory compliance.
3. Examine how HRA supports sustainable workforce management by aligning HR practices with economic, social, and environmental sustainability goals.
4. Propose a practical maturity pathway defining progressive stages of analytics capability for textile firms.

LITERATURE REVIEW

***Evolution of HRM and Emergence of Analytics*:** The evolution of human resource management (also known as HRM) is indicative of broader changes in management thinking, organizational strategy, and technological developments (Margherita, 2022; Roul et al., 2025). Traditionally, HRM in both developed and developing economies has been viewed primarily as an administrative or support function, encompassing tasks such as maintaining personnel records, monitoring attendance, processing salaries, and ensuring compliance with labor laws. In the early industrial years, particularly in labor-intensive businesses like textiles, HR practices had little connection to strategic planning and workforce integrity; instead, they focused on discipline, labor relations, and ensuring a safe working environment (i.e., maintaining a quiet and efficient work environment on the floor) (Peeters et al., 2020; "Raging Debates in HR Analytics," 2012). This transactional orientation prevailed throughout much of the twentieth century, especially in economies dominated by manufacturing industries, such as Pakistan, where HR departments were often relegated to a lower position in large organisational charts (Levenson, 2005).

By the late twentieth and early twenty-first century, however, the field of HRM changed significantly. Several things contributed to this change. First, the resource-based view (RBV) of strategy, which posits that human capital serves as a source of sustainable competitive advantage, redefined employees not as a source of costs but as assets (Levenson, 2018). Second, globalization and the emergence of knowledge economies stressed not only the role of the skilled labor force, innovation, and organizational learning, but also highlighted the importance of these factors. Digitalization has enabled new paths for data gathering and analysis, which are beginning to transform HR practices worldwide (Gurusinghe et al., 2021). There was an explosion of human resource information systems (HRIS) in the 2000s, which digitized the basic HR activities. Initially, such systems were used to automate administrative tasks, such as payroll and attendance; however, these applications gradually evolved to include recruitment, training, and performance management. However, things really changed with the rise of people analytics, also known as HR analytics (HRA) (Gurusinghe et al., 2021). HRA went beyond HRIS for record-keeping to predictive modeling and data-driven decision-making. Instead of simply recording the narrative of what had occurred, HRA helped organizations analyze not only why it happened but also what could occur in the future (Lunsford, 2019).

In the advanced economies, HRA soon came into its own. Tech giants like Google initiated analytics projects, such as "Project Oxygen" and "Project Aristotle," which analyzed their management practices and team dynamics using data

science approaches. IBM claimed that its attrition model, which relied on artificial intelligence, was able to predict turnover with a 95% degree of accuracy (Qamar & Samad, 2022). These significant, well-profiled cases helped to inspire the use of analytics as a strategic tool among global firms. At the same time, the impact of the digital transformation triggered by the pandemic has led to an accelerated drive for transformation across industries. Organizations were confronted with unprecedented workforce disruptions, demanding real-time visibility to absenteeism, productivity related to remote work, and employee well-being. Surveys show that by 2023, over 70% of Fortune 500 companies had established their own people analytics teams (Andersen, 2017; Simón & Ferreiro, 2018). In this sense, the pandemic made the strategic role of workforce data in organizational resilience clear.

In Pakistan's textile sector, however, the evolution has been sluggish. Most firms continue to see HR as an administrative function. Payroll, attendance, and compliance reporting are the primary HR activities; moreover, analytics are often not integrated into decision-making processes. However, pressures from international buyers and compliance frameworks are marginally changing this perception (Aral et al., 2012; Brock, 2017). Export-oriented firms are beginning to experiment with dashboard development and workforce KPIs, which suggests a growing, yet early, understanding of HRA's potential. The shift in focus from transactional to strategic HRM, supported by analytics, is particularly relevant in labor-intensive industries such as textiles. The challenges faced by these industries include high absenteeism rates, frequent staff turnover, and issues related to occupational safety compliance, among others. In such circumstances, the option to predict the workforce trends, optimize their scheduling, and record compliance is not just desirable but vital (Saxena et al., 2021). Thus, the emergence of HRA signifies a continuation of the strategic evolution of HRM, while also responding to the diverse needs imposed by globalization and sustainability.

***Conceptual Foundations of HRA*:** The process and impact of HRA on distinction are available for analysis in multiple theoretical lenses. One of the most influential is the resource-based view (RBV), which argues that resources that are valuable, rare, inimitable, and non-substitutable (VRIN) provide a sustainable competitive advantage. Human capital clearly fits in this category, but in the absence of data-driven insights, it is not readily strategically manageable. HRA implements RBV by making human capital quantifiable so that firms can align the performance of the workforce to the financial and operational results (Mishra et al., 2019). The other model is the Technology-Organization-Environment (TOE) model, which proposes that technological preparedness, organizational context, and environmental pressure of a particular organization determine the adoption of technology. Technological preparedness refers to the availability of IT infrastructure, the quality of data, and interoperability. Leadership commitment, culture, and HR data literacy are important in the organizational context. Forces affecting the environment, such as regulatory demands, customer demands, and competition (Ioakeimidou et al., 2024). TOE comes particularly in handy when the researcher is studying adoption in developing economies, where technological and organizational limitations often collide with strong external forces.

At the personal level, some factors influence adoption, as explained in the Unified Theory of Acceptance and Use of Technology (UTAUT). An example of this is that HR professionals will be more inclined to embrace analytics when they perceive it as applicable, simple to use, and supported by their colleagues or superiors. Research indicates that the ability to use HR data is a decisive element in adoption. Without proper training, HR professionals are not aware of how to use HR data analysis. The strategic integration of analytics is usually nullified by the reliance of HR professionals on IT departments (Benson et al., 2002). Another perspective is institutional theory, which offers valuable insights. This means that organizations do not just assume practices based on efficiency, but also in response to coercive, normative, and mimetic pressures (Lunsford, 2019). The compulsive forces of foreign consumers and global authorities are extreme in the environment of the Pakistani textile industry. The normative pressures are based on ILO standards and frameworks of sustainability, while the mimetic pressures are driven by competitors who utilize analytics to build trust with buyers. The combination of these forces results in a climate where adoption tends to be extrinsically, rather than intrinsically, motivated.

Lastly, the emerging body of research on sustainable HRM (SHRM) makes HRA one of the means of achieving the optimal balance between economic, social, and environmental objectives (Kumar et al., 2020). Economic sustainability through efficiency and cost savings, social through openness of fair labour, safety check-ups, compliance, and environmental, minimising waste and amortization of environmentally friendly energy efficiency. By relating HRA to SHRM, scholars highlight its contribution to the achievement of the UN Sustainable Development Goals (SDG 8: Decent Work and Economic Growth) (Kailay, 2024; Khawaja et al., 2024). Together, these conceptual foundations provided a multidimensional framework for the study of HRA adoption. RBV focuses on the strategic value of human capital, while TOE emphasizes contextual factors. UTAUT explains individual adoption, and institutional theory addresses external pressures. SHRM refers to the ESG contextual connection of sustainability. This study combines these perspectives to analyze the drivers, barriers, and impacts of HRA in the Pakistani textile sector.

***Global Adoption and Barriers*:** Globally, the adoption of HRA has accelerated, but it remains patchy both by industry

and by geography. In knowledge-intensive industries, such as IT, banking, and consulting, analytics is commonly employed to optimize recruitment, predict officer attrition, and evaluate training initiatives (Management et al., 2025). In manufacturing, they are slower to adopt, but they do experience growth especially in industries exposed to global compliance standards. Surveys indicate that in 2023, approximately 70% of multinational corporations had established people analytics teams, while only 20-30% possessed advanced maturity and were utilizing predictive and prescriptive models (Pezzutto et al., 2024). Those that exist are at the descriptive stage, creating dashboards and reports, but have not yet been integrated in-depth into the strategy.

The barriers to adoption are elaborated in Table 1. Technological barriers, including fragmented HR systems, poor data quality, and a lack of interoperability, frequently hinder the ability to analyze data effectively. Many organizations that digitize their payroll and attendance processes begin their analytics tasks in shallow waters,

Table1. Barriers to HRA Adoption, Sustainability Implications.

Category	Barrier	Economic Impact	Social Impact	Environmental Impact	References
Technological	**Lack of integrated HRIS –** HR systems fragmented (payroll, attendance only); no link to performance or production.	Higher costs, poor efficiency	Unfair scheduling, weak retention	Rework, material waste	Wang et al., 2024; Deloitte HIPeople Analytics, 2023 Deloitte HCT 2024.
	Poor data quality – Inaccurate biometric/attendance data; no standardization across units.	Wrong decisions, high turnover	Low trust, perceptions of unfairness	Idle time, excess waste	NIST AI RMF 1.0 (2023); Iqbal et al., 2025; Sciences et al., 2022 ;
	Limited interoperability – HR data not linked with ERP/MES; weak business case for HRA**.**	No ROI visibility	Skill mismatch persists	Scrap from poor planning	Pezzutto et al., 2024
	Weak cybersecurity/privacy – Fear of misuse of sensitive HR data slows digitization.	Delayed digital adoption	Worker distrust, under-reporting	Paper-based backups = waste	
Organizational	**Low leadership support –** Analytics not prioritized; seen as non-strategic.	Missed efficiency gains	HR stays transactional	Inefficient practices continue	Wang et al., 2024; SHRM Exec Forum, 2022.
	HR data literacy gaps – HR staff lack analytical skills; depend on IT teams.	Lost savings, weak planning	Weak fairness, low empowerment	Indirect: rework rises	Margherita, 2022; Roul et al., 2025; Deloitte HIPeople Analytics, 2023
	Cultural resistance – Managers prefer intuition and hierarchy over data.	Inefficiency persists	Favoritism, unfair treatment	Trial-error waste	Deloitte HCT 2024; Pezzutto et al., 2024
	No KPI definitions/ownership – Inconsistent reporting, no accountability.	Benchmarking impossible	Confusion among workers	Repeat audits waste energy	
Environmental	**Buyer pressure –** International brands demand transparent reporting on turnover, overtime, safety.	Market loss if weak	Higher labor standards	Leaner, efficient processes	Pakistan Accord (2023); Vogue Busine ss 2024; Better Work Pakistan (2022)
	Regulatory demands – Accord/ILO inspections push systematic workforce data collection.	Reporting inefficiency	Safety & well-being improved	Prevent disruptions/waste	ILO DWCP Pakistan 2023–27
	Competitive pressure – Firms without analytics risk losing export contracts.	Contracts lost	Buyer trust eroded	Indirect eco benefits	Deloitte HIPeople Analytics, 2023.
Other (Ethical/Financial)	**Privacy concerns –** Workers fear monitoring; stress, under-reporting.	Low participation	Stress, distrust	Paper overload	NIST AI RMF 2023; Reuters Workday case 2024; Rex et al., 2020; Deloitte HCT 2024; Rasmussen et al., 2024; NIST AI RMF 2023
	High costs/vendor lock-in – SMEs see analytics tools as expensive, risky contracts.	Stalled digitization	HR overload in manual tasks	Print/logistics waste	
	Pilot purgatory – Analytics pilots not scaled across units.	No efficiency gains	Inequalities across sites	Waste continues	
	Model misuse/misinterpretation – Correlation seen as causation; bias risks.	Wasted resources	Harm to vulnerable groups	Churn leads to scrap	

forgetting to incorporate performance or training data, which restricts the extent of analytics (Galizia et al., 2015). Organizational barriers include low leadership commitment, a lack of HR data literacy skills, and cultural resistance. Managers may view analytics as stripping them of their ability to direct and are more inclined to trust their own intuition and experience (Galizia et al., 2015). Environmental barriers include weak domestic regulation and intense external pressure from buyers and global frameworks. In Pakistan, for example, the Pakistan Accord (2023) and the ILO Decent Work Country Programme (2023-2027) require firms to maintain systematic workforce data. Ethical barriers include privacy concerns, the potential for misuse, and algorithmic bias (Iqbal et al., 2025; Sciences et al., 2022).

Moreover, these barriers are exceptionally high in developing economies. Resource constraints are barriers to investing in HRIS, whereas cultural factors determine the level of resistance to change. SMEs often lack the scale or expertise to justify investing in analytics. However, external pressures applied by buyers often prompt the adoption of analytics by export-oriented firms, creating an uneven landscape where larger firms move forward while smaller and medium-sized firms lag (Management et al., 2025); Rex et al., 2020). Similar dynamics are suggested by anecdotal evidence from Pakistan's textile sector. Larger firms with international buyers are experimenting with the use of dashboards; smaller firms are still locked into manual systems. The challenge is moving from compliance-driven adoption to a strategic integration of analytics that supports not only audits but also long-term sustainability.

The barriers identified in the literature do not merely slow digital HR adoption; they directly undermine sustainability in Pakistan's textile sector. Fragmented systems and poor data quality erode economic sustainability by obscuring overtime costs and driving rework. Weak data literacy and cultural resistance hinder social sustainability, resulting in inconsistent scheduling, fairness concerns, and slower responses to safety risks. Governance gaps and pilot purgatory perpetuate environmental inefficiency through preventable defects and energy waste. By reframing mitigations such as data governance, targeted upskilling, privacy-by-design, and disciplined scaling—as sustainability levers, firms can convert HRA from a compliance checkbox into a sustainable HRM engine that supports SDG 8 (Decent Work & Economic Growth) while strengthening export competitiveness.

***HR Analytics, Sustainability, and Developing Economies*:** The synthesis of HRA and sustainability is a promising and under-researched area. The concept of sustainable practices involves balancing economic, social, and environmental goals. HRA can play a role in this balance by offering credible information that is correlated with sustainable goals, aligning workforce practices with sustainability objectives (Kailay, 2024; Kumar et al., 2020). For economic sustainability, HRA saves money by placing minimal demands on turnover, scheduling optimal shifts, and correlating training to productivity outcomes. For social sustainability, it ensures the scheduling of labor, compliance with standards, and monitoring of labor occupations to enhance occupational safety (Khawaja et al., 2024). For environmental sustainability, the association is indirect; however, HRA mitigates inefficiencies, thereby reducing the waste of energy and materials. In developing economies, it is common for a global supply chain to impose sustainability externally. However, buyers are more demanding than ever before, not only in terms of compliance but also in terms of evidence-based data demonstrating sustainable labor practices. Programmes like Better Work Pakistan (ILO, 2022) reflect this trend. Firms that use analytics are in a better position to prove compliance and win buyer trust (Iqbal et al., 2025; Kamran et al., 2020).

However, adoption in developing economies is subject to distinct constraints. Resource constraints, skill constraints, and poor national laws are placing constraints on the possibilities. At the same time, there are intense pressures from outside the community, which provide incentives. Research in India and Bangladesh is confirming that adoption is primarily driven by compliance, and strategic integration is low (Anner et al., 2022; Khan et al., 2015; Management et al., 2025). In the case of Pakistan, similar tendencies are emerging, but there is little or no empirical research. This study helps bridge the gap by examining how the use of HRA in Pakistan's textile industry supports sustainable workforce management. By analyzing technological, organizational, and environmental factors, it aims to understand how analytics can transition from a compliance tool to an enabler of strategic sustainability.

MATERIALS AND METHODS

This research employs a qualitative, interpretivist design to investigate the adoption and impact of Human Resource Analytics (HRA) in the Pakistani textile sector, with a focus on sustainable workforce management (Naeem et al., 2023). A multi-case, interview-based approach was chosen because it allows in-depth exploration of managerial perspectives and organizational practices in real-world contexts. 15 textile firms from Punjab and Sindh, spanning spinning, weaving, garments, and home textiles, were purposively selected, as they represent Pakistan's core export base. Within these organizations, 30 semi-structured interviews were conducted with HR managers, analytics specialists, operations supervisors, and compliance officers, ensuring diversity in roles and experiences. Interviews lasted between 25 to 40 minutes, were conducted in English or Urdu, and transcribed directly with participant consent.

Data collection was guided by an interview protocol structured around four domains: technological readiness

(HRIS, data quality, system integration), organizational factors (leadership commitment, HR data literacy, cultural attitudes), environmental pressures (buyer audits, regulatory expectations, competitive dynamics), and perceived outcomes (decision-making, cost savings, compliance, sustainability). Alongside interviews, organizational documents such as HR manuals and compliance reports were reviewed to triangulate findings and strengthen validity. A hybrid coding strategy was applied, combining deductive codes from the Technology–Organization–Environment (TOE) framework and sustainable HRM literature with inductive themes emerging from participants' accounts (Cernasev et al., 2023).

Data were analyzed using NVivo software following Braun and Clarke's six-step thematic analysis process: familiarization, coding, theme generation, theme review, definition, and reporting (analysis 2019). Four main themes emerged Technological Readiness, Organizational Factors, Environmental Pressures, and Perceived Impacts with sustainability embedded across all. Trustworthiness was ensured through member checking, triangulation of data sources, and maintaining an audit trail of coding decisions. Reflexivity was practiced by minimizing researcher bias. This methodology provides a rigorous basis for exploring how the adoption of HRA shapes sustainable workforce management in Pakistan's textile sector.

RESULTS

***Demographics*:**

Table 2. Demographic Profile of Interview Participants (n = 30).

Variable	Category	Freq. (n)	(%)
Gender	Male	22	73.3
	Female	8	26.7
Age Group (years)	30–39	9	30.0
	40–49	13	43.3
	50 and above	8	26.7
Educational Qualification	Bachelor's (Business/HR/Engineering)	11	36.7
	Master's (HRM/Management)	15	50.0
	Professional Certifications (HR Analytics, Compliance, IT)	4	13.3
Work Experience	8–12 years	12	40.0
	13–17 years	18	60.0
Job Role	HR Managers/Directors	10	33.3
	Analytics/HRIS Specialists	6	20.0
	Operations/Production Managers	7	23.3
	Compliance & Audit Officers	7	23.3
Firm Type	Spinning & Weaving	8	26.7
	Garments & Apparel	10	33.3
	Home Textiles	6	20.0
	Vertically Integrated (end-to-end)	6	20.0

***Analysis*:** The qualitative data from interviews were coded in NVivo using a hybrid approach: deductive codes derived from the TOE framework (Technology–Organization–Environment) and inductive codes emerging from participant narratives. Four major themes were identified, each with relevant subthemes, as discussed below:

DISCUSSION

The findings of this study reveal a complex yet promising picture of Human Resource Analytics (HRA) adoption in the Pakistani textile sector. Using thematic analysis, it became evident that there are four major dimensions: technological readiness, organizational factors, environmental pressures, and perceived impacts. Each of these themes provides insight not only into how analytics is currently understood and implemented, but also into how it contributes to sustainability on the economic, social, and, indirectly, environmental dimensions.

An underlying theme, which was Hansen's takeaways after the visit and discussions, is the uneven technological preparedness of the textile companies. Larger export-oriented companies had invested in basic HR information systems to broadly cover payroll and attendance, whereas small and medium-sized companies, often had a manual or fragmented system—this level of limited technological base hinders the industry's ability to utilize analytics effectively. However, the adoption of dashboards in some firms is encouraging development. Dashboards for tracking absenteeism and overtime, while crude, form a basis for economic and social sustainability (Giermindl et al., 2022; Marler & Boudreau, 2017). They enable companies to optimize the allocation of their workforce, reduce costly overtime, and ensure that bureau costs are fairly distributed between workers. However, issues with data quality significantly impede the effort. Incomplete biometrics and sketchy records are the basis for distrust in the system, causing managers to be reticent about trusting the results of analytics and using them in decision-making. Without the correct data, the potential for sustainable HR practices —such as fair scheduling, enhanced safety tracking, and meticulous reporting—cannot be fully realised. Firms see the potential of analytics, but their basic digital infrastructure has gaps that diminish credibility and effect (Bahuguna et al., 2024; Torraco & Lundgren, 2020).

The study also highlights the importance of organizational factors, specifically leadership commitment, talent management, data literacy, and cultural resistance. Leadership emerged as a decisive factor in whether firms would lean beyond compliance-based reporting toward analytics-based strategic workforce management. At those firms where CEOs and top HR executives set a message that HRA is a purposeful investment in sustainable growth, adoption was stronger, and employees tended to see greater value in analytics (Yasmin et al., 2020). This suggests that it

Table 3. Thematic Coding Matrix.

Main Theme	Subthemes	Representative Quotes	Sustainability Dimension
Technological Readiness	Basic HRIS Adoption	*"We only use software for salaries and attendance. Performance or training records are kept manually."*	**Economic** – Limited digitalization restricts efficiency and prevents workforce optimization.
	Data Quality Issues	*"Sometimes the biometric system fails, and we end up with gaps in attendance data, which makes analytics unreliable."*	**Social** – Poor data weakens ability to track absenteeism and overtime, risking worker fatigue and unfair scheduling.
	Emerging Dashboards	*"We recently started using dashboards to monitor overtime and absenteeism."*	**Economic & Social** – Dashboards improve efficiency and ensure fairer workload distribution, contributing to sustainable labor practices.
Organizational Factors	Leadership Commitment	*"Our top management believes analytics is the future, so we invested in dashboards to improve HR decisions."*	**Economic & Social** – Leadership fosters sustainable HRM by balancing cost efficiency with employee well-being.
	HR Data Literacy	*"HR people don't have the analytical training. They ask us to generate the simplest reports."*	**Social** – Skill gaps hinder sustainable HRM; investment in HR data literacy promotes inclusive workforce management.
	Cultural Resistance	*"We've been making decisions based on experience for years. Now they want to replace it with numbers."*	**Social** – Resistance delays adoption of sustainable, transparent HR practices.
Pressures	Buyer & Compliance Requirements	*"The brands want monthly reports with numbers. Without analytics, we cannot provide them quickly."*	**Social & Economic** – Compliance ensures fair labor conditions and secures long-term market access.
	Regulatory Expectations	*"Accord inspections require us to maintain proper workforce records."*	**Social** – Regulatory frameworks enforce sustainability in occupational health and safety.
	Competitive Pressures	*"Our buyers trust us more because we can show them data on our workers."*	**Economic** – Analytics enhances sustainable competitiveness by building buyer confidence.
Perceived Impacts of HRA	Improved Decision-Making	*"Analytics helped us predict absenteeism patterns and adjust shifts accordingly."*	**Social** – Better planning reduces worker fatigue and improves fairness.
	Cost & Efficiency Gains	*"By analyzing absenteeism and overtime, we saved a significant amount last quarter."*	**Economic** – Cost reductions strengthen organizational sustainability and resilience.
	Enhanced Compliance Documentation	*"Audit processes are smoother now since reports can be generated quickly."*	**Social & Economic** – Ensures ethical labor practices and secures buyer trust for sustainable trade.
	Early Warning Systems	*"We are piloting models to identify workers at risk of leaving within six months."*	**Social** – Supports sustainable retention strategies by addressing worker concerns proactively.

is not only through leadership that technologies become adopted, but the leadership of tone-enabling analytics synergises with broader sustainability agendas.

By emphasizing worker well-being, fair practices, and efficiency as collective goals, leaders can ensure that analytics is not a threat to managerial judgment in practice. However, there is a significant and widespread impediment: the lack of literacy in HR data (Adel, 2022). Many HR professionals admitted that they were not comfortable handling data and analytics information and instead leaned on IT staff for even the most basic reporting information. This dependency hinders the capacity to add to HR and make a strategic partner, while RAMs depress the requirement for sustainability figures. Sustainable HRM requires HR practitioners to work with evidence, rather than relying solely on intuition, and in the process, to encourage fairness and accountability in decision-making. Without building analytical capabilities in HR teams, the sector risks getting trapped in a cycle in which analytics remain more of a technical act than an embedded role within the organisation. Cultural resistance is predominant in this issue. In the interviews, line managers/individual supervisors emphasised their preference for experience and judgement over "numbers" on the floor (Thite, 2022). For them, analytics meant disturbance of the existing hierarchies and authorities. This finding is consistent with other literature in the field globally, resistance as a hidden, yet powerful parameter against digital transformation. In Pakistan, a relationship with authority are often the deciding factor, in a situation where analytics has often undervalued the line of authority (Google in the Works, How the Online Newspaper Resisted Google, 342-343) the secession with analytics takes on a different valence: It is not just about skepticism but a matter of maintaining identity and power within the hierarchy of the organization (Brito et al., 2025).

The results also show the great extent to which environmental pressures matter for HRA adoption. International buyers, compliance regimes, and designs regarding competition have

a significant impact on companies' approaches to analytics. In most cases, analytics adoption is externally motivated and not internally driven (Thite, 2022). Buyers required every monthly or quarterly report that included supported data on workforce indicators such as turnover, absenteeism, and safety incidents. Compliance frameworks (for example, the Pakistan Accord on Health and Safety) further enhanced these demands and emphasised the need to document systematically. In this context, the role of analytics has often been viewed as a compliance and reputation management tool, rather than as a strategic tool for workforce development and growth. Nevertheless, the connection between analytics and sustainability so far lies in a harmonious alignment of buyer standards, which is based on a bond to social sustainability, to ensure good behavior in terms of labor practices and safe working conditions (Simón & Ferreiro, 2018). It also became a motivating force of the competitive forces. Companies alleged that the transparency provided by analytics instilled confidence among buyers and, in other cases, gave buyers an upper hand over their competitors. This is a positive indicator that, although a compliance need might drive the original application of analytics, it can and will have a strategic payoff. However, more to the point, it reorganized the environmental management as an optional extension to a competitive mandate. By demonstrating that they are practicing a sustainable type of HR and triangulation that aligns with the Times, firms enhance their credibility within the global market and contribute to the long-term economic sustainability of the organization. It is specifically applicable to Pakistan, which also has a textiles exportation industry and jobs connected with it (Ratnam & Devi, 2024).

The final theme, the perceived effects of HRA, provides insight into the potential contribution of analytics to sustainability results, even at lean stages of utilisation. Another advantage that was reported more frequently was increased decision-making. Companies have noted that analytics help identify trends in absenteeism, enabling managers to allocate shifts more objectively and effectively. The specified type of industry not only facilitated increased productivity but also contributed to improving social sustainability by reducing work strain and redistributing workloads among employees. Similarly, the theoretical examples of the reported cost and efficiency benefits are perfect examples of what analytics can do to support economic sustainability (McCartney & Fu, 2022). By arranging unnecessary overtime and addressing work and production demands, companies can save money and address the health-related issues affecting their staff members. The other primary impact was the impact that HRA had on compliance documentation. The companies reiterated that analytics made the audit preparation process easier, eliminated administrative overhead, and helped the company become more transparent in its interactions with buyers. This position may be regarded as one of the direct means by which HRA influences the establishment of social sustainability, as labour standards are at least maintained. It has a more significant impact on economic sustainability, as it ensures access to global markets (Margherita, 2022). Another indicator of the potential value that HRA can lead to in terms of enabling sustainable approaches to retaining workforces is the recent, still unrealised applications of predictive analysis (e.g., early notification systems that help identify employees at risk of leaving). Such initiatives are experimental; however, they represent a progressive step that would assist companies in addressing turnover (one of the most pressing social sustainability concerns in industry).

Together with the findings, the HRA adopted by Pakistani textile organisations can only be described as an environmentally based sustainability process. When examining the explanation of HRA as an instrument of strategic alignment and performance optimization in the global literature, in the Pakistani context, HRA serves as a tool for compliance with sustainability requirements that buyers and regulators impose equally. It does not mean that it is less valuable in the field of strategy; instead, it restores analytics as a means that meets two key demands: compliance and competition (Yoon et al., 2024), including social sustainability, improved scheduling, and enhanced safety monitoring and compliance. The ultimate results are cost reduction, increased profitability, enhanced efficiency, and increased consumer confidence in the marketplace, which further strengthen such efforts. The decrease in waste production, which may ultimately lead to reduced energy consumption, is beneficial to the environment, although it does not have a direct impact.

Nevertheless, managing the workforce is one part of the solution. The other important paradox raised by the discussion is the critical motive that leads to taking the implicit step of adopting HRA, which seems external rather than excellent internal strategies. There is a question of whether adoption will be comprehensive and foster a culture of sustainable HRM, or if we are going through the motions. However, as the evidence shows, although the scale of adoption can be confined to compliance, it can also evolve into more strategic approaches once firms begin to realize the benefits internally. Because dashboards and straightforward analytics can be represented as having value in reducing costs and increasing transparency, this could lead to a less traumatic resistance within the organization and administration to acknowledge analytics to help balance short-term optimism and long-term sustainability.

Implications: The implications of this study are considered important for firms, policymakers, and international buyers operating in Pakistan's textile industry. For firms, the results highlight that Human Resource Analytics (HRA) can serve as a foundation, rather than a compliance mechanism, for sustainable HRM. Even simple analytics, such as absenteeism dashboards, provide both economic benefits (avoiding

overtime expenses and increasing productivity) and social benefits (distributing the workload more fairly and creating safer workplaces). Organizations should therefore consider HRA a route to achieving a balance between efficiency and employee well-being. However, the persistently displayed skill gaps among HR professionals illustrate the high demand for capacity-building programs in HR data literacy, enabling HR teams to make strategic use of analytics without relying on IT departments.

For policymakers, the study underscores the importance of incorporating HRA into national labor and industrial policies. By coupling HRA adoption with incentives for sustainability—such as tax credits, training subsidies, or recognition schemes—the government can encourage firms to adopt practices that are data-driven, conducive to compliance and labour rights, and competitive. In a sector that lies at the core of Pakistan's economy, such support would help reinforce both the country's national sustainability targets and its alignment with the UN's Sustainable Development Goal 8 (Decent Work and Economic Growth). For international buyers, the results indicate their sustainability requirements are strong external drivers of analytics adoption. However, compliance demands alone may not be sufficient to develop sustainable HRM practices if buyers do not provide capacity-building support to their supplier networks. Partnerships that blend data requirements with training, infrastructure support, and fair pricing can ensure that analytics adoption improves not only compliance reporting efforts but also supports workforce sustainability over the long haul.

***Conclusion*:** This study examined the adoption and impact of Human Resource Analytics (HRA) in the Pakistani textile sector, employing a qualitative research approach that included interviews. The analysis revealed that adoption is still in its early stages, hindered by a combination of poor technological readiness, skills gaps, cultural resistance, and intense external pressures from buyers and compliance regimes. Despite these barriers, companies that have invested in analytics processes have claimed real benefits in decision-making, cost efficiency, compliance reporting, and workforce planning. Significantly, these outcomes contribute directly to the following aspects of sustainability: Economic sustainability (through the efficiency gains whilst improving labour practice and meeting global standards), Social sustainability (through the improvements to labour practices and the ensuing standards compliance), and, indirectly, environmental sustainability (through the optimisation of workforce and reduction of waste).

The results place HRA not only as a performance-enhancing tool but also as a sustainability enabler in Pakistan's textile sector. Within the broader agenda of sustainable HRM, this study demonstrates how analytics-driven practices can be leveraged to create fairer, safer, and more resilient workplaces, while also enhancing competitiveness in global supply chains. The sector is clearly at a critical juncture; businesses that not only accept HRA as part of an approach to a sustainable workforce will be better positioned to thrive in a time of greater buyer scrutiny and commitments to global sustainability.

***Future research directions*:** This study raises several areas for further exploration. Future research could incorporate quantitative HR-related data (e.g., absenteeism, turnover) to validate the effects of analytics that are only observed qualitatively. Longitudinal studies are necessary to examine how compliance-based adoption evolves and matures into strategic, sustainability-oriented adoption over time. Exploring the employee perspective would also make them even more interesting, especially in terms of trust, fairness, and privacy in the use of HR data. Finally, cross-sectoral and comparative studies could reveal whether the patterns of adoption observed in the textiles are peculiar or representative of broader trends in the Pakistani economy.

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